is built, the kind of engines used to propel it when cruising on the surface and when submerged, the armament, and many other details. All his explanations are well illustrated. After a brief discussion of the tactics of the submarine, the book goes on to describe and illustrate a great number of devices employed—not all successfully—to track and destroy the U-boat. There are many American devices the value of which has probably been exaggerated—indeed, some of them are merely fantastical suggestions—and these, with others, are given to render the work complete. The concluding portion of the book deals with the many plans that have been put forward from time to time for salving sunken ships or their cargoes. Here, again, it remains for experience to show whether any of them are of value. It is not claimed that Admiral Bravetta's work can be of practical technical value, but as a well written and illustrated record of the achievements of human ingenuity in combating a menace to the world's safety it is well worth perusal by all who are able to follow semi-technical Italian. In fact, an English translation might well fill a want until some similar work is compiled in our own language. E. S. H.

Birdland's Little People: Twelve Nature Studies for Children. By Capt. Oliver G. Pike. Pp. 123. (London: The Religious Tract Society, 1919.) Price 4*s*. 6*d*. net.

THE author of this volume is well known as a popular writer on natural history, and presents in the work before us an excellent series of essays, written in an interesting style, on the habits and haunts of several of the most attractive members of the British avifauna. The subjects are well chosen, and include certain feathered denizens of our gardens, lanes and copses, the reedy lake and the breezy moorland. In each case the love-making, nest-building, and subsequent care of eggs and young nestlings are described graphically from personal observation, so that the book is not a mere compilation, but a vivid account of bird-life written with the enthusiasm of a true lover of feathered creatures and their entrancing ways. The book will interest any boy or girl possessing a fondness for animal life (and this, we fancy, includes the majority of young people), while at the same time the various phenomena are so accurately and carefully described that persons of maturer years may read its pages with advantage. The birds selected include two species of grebe, two of warbler, the kingfisher, dipper, brown owl, lapwing, wren, cuckoo, whitethroat, great tit, and buzzard. The parasitic habits of the cuckoo, the cannibalistic propensities of a young buzzard, and the mysteries of migration are among the more interesting phenomena touched upon in a book which is well printed and illustrated by a series of twenty-four excellent reproductions of photographs taken from Nature by the author himself.

LETTERS TO THE EDITOR.

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Velocity of Electric Currents.

WHILE the velocity of electric waves is well known, as Maxwell and Heaviside have pointed out, we know absolutely nothing of the velocity with which electricity travels in a wire. As Heaviside says ("Papers," vol. ii., p. 3, line 4):—"It may be an inch an hour or it may be immensely great."

Mr. Aston's extremely interesting discovery (NATURE, June 5, p. 275), that the striæ in capillary tubes containing neon or helium travel with approximately the same velocity as that of sound in the gas, is of interest in connection with the fact pointed out by the writer in *Science* for July 22, 1892, and more fully in the *Physical Review* for March, 1900, that "resistances of equi-molecular wires of pure metals are proportional to their transmission times for sound-waves" (to an accuracy of about 3 per cent.), and is in line with the suggestion made in the *Physical Review* paper referred to (March, 1900), that the time of travel of electricity in wires is the same as that of sound.

The double coincidence for metals and gases is at least suggestive, and further work along these lines might give results of interest.

If cohesion depends on the electrons in the outer rings, the tensile strength of the lead isotopes should be the same; but might not their electrical resistance and sound velocities (easily determined for small quantities of material by resonance methods) afford a means of distinguishing them?

REGINALD A. FESSENDEN.

185 Franklin Street, Boston, Mass., U.S.A.,
August 5.

The Magnetic Storm of August 11–12, 1919.

THE earlier months of 1919 showed a great deal of magnetic disturbance, but for some two months past conditions have been unusually quiet. On the morning of August 11, at about 7h. G.M.T., there was a "sudden commencement," followed by the largest magnetic storm experienced for some years at Kew Observatory. Conditions remained highly disturbed until near 10h. on August 12, when the photographic sheets were changed. The range in declination was 2° 5′, and that in vertical force 935 γ. The horizontal-force trace was twice beyond the limits of registration, on each occasion for more than ten minutes; thus the range shown, 840 γ, may have been considerably exceeded. Many of the movements were too rapid to be shown clearly in the trace. Rapid oscillations were especially in evidence between 7h. and 10h., and again between 14h. and 18h., on August 11. The declination curve also showed smaller but very rapid oscillations from midnight to 9h. of August 12. The extreme easterly reading, 13° 44′ W., was recorded at about 8h. of August 11, and the extreme westerly reading, 15°. 49′ W., at about 16h. 32m.

The commencing movements near 7h. of August 11

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were of an unusual character. In declination swings of 10′ to west, 20′ to east, and again 62′ to west followed in immediate succession. In horizontal force there was, as usual at the start, a rapid rise, amounting to 75 γ; but in less than a minute the movement was reversed, and a fall exceeding 450 γ in less than twelve minutes took the trace off the sheet. Horizontal force remained depressed for nearly 1½ hours, but then for a few minutes it was above the normal value. Another large fall then ensued, which carried the trace off the sheet from 9h. 15m. to 9h. 25m. Between 14h. and 17h. of August 11 horizontal force was usually above the normal. The maximum, which appeared synchronously with that in vertical force at about 16h. 2m., exceeded the value prior to the sudden commencement by 460 γ. The disturbance in vertical force, though exceptionally large, was of the usual type. During the afternoon of August 11, from 14h. to 18h., the curve was of a pyramidal shape, the value of the element being much enhanced. By 23h. the curve had resumed its normal level, and a depression then set in, the minimum being reached just after 2h. on August 12.

The ranges recorded during this storm have seldom been approached at Kew Observatory. In fact, it is unlikely that so large a range has ever been recorded there before in vertical force. But for the great reduction in sensitiveness made of late years to meet the conditions caused by electric trains and trams, the maximum would have been far beyond the limits of registration.

C. CHREE.

Kew Observatory, Richmond, Surrey,
August 13.

THE magnetic storm which began on the morning of August 11 was one of the largest recorded in recent years, and was probably of world-wide distribution. It attracted public attention chiefly through the notable—though not unusual—extent to which it interfered with telegraphic work. On account of its somewhat exceptional features, the following statement of results of observations at Eskdalemuir Observatory may be of some interest, and is communicated by permission of the Director, Meteorological Office.

The times given below are Greenwich mean times. The unit of 1 γ is 0·00001 C.G.S. It should also be mentioned that the principal magnetographs at Eskdalemuir are so arranged as to give directly the vertical (V), north (N), and west (W) components of terrestrial force; a declination magnetograph is also in operation.

The conditions prior to the advent of the storm were those of a magnetically quiet day. Very slight disturbance was recorded between 20h. and 21h. on August 10, and pulsations of about three minutes' period were observed on N about an hour after midnight. The beginning of the storm as observed at Eskdalemuir may be taken as having occurred at 6h. 58m. on August 11. But this beginning differed very considerably in its character from the usual type of what is known as a "sudden commencement." Ordinarily, this phenomenon exhibits a rise in the value of the horizontal force; a rise also, though usually smaller, in declination; and in some instances a fall in the value of the downward directed vertical force. So far as is known, these abrupt changes take place simultaneously at any one place, and (in spite of attempts to prove the contrary) there is no trustworthy evidence to show that they are not synchronous at all observatories. In the case of the storm now considered, however, a minor disturbance of somewhat unusual type began on the north component thirty-two minutes before the other components experienced the sudden commencement of the storm. There is nothing to show that this minor disturbance had any relation to subsequent events or was other than "accidental," but it is mentioned for what it may be worth, and as being the cause of a doubtful estimate as to the time of the sudden commencement on the north component. At all events, the disturbance began at 6h. 58m. so suddenly as to send the light spot completely off the recording sheet, and did so with such rapidity that it is impossible to state whether the change was one of increase or decrease in force. But while there is no photographic trace immediately after 6h. 58m. on the + side of the undisturbed value, there is distinct evidence of its being *below* that value within a minute after that time. In another respect, the beginning of the storm was altogether exceptional in that the sudden commencement on the vertical-force magnetograph showed but the faintest trace of any decrease in value, and in reality was followed by a large increase. On the west component record there is shown a sudden rise and fall, the difference between the extremes being 172 γ.

After the rapid changes associated with the sudden commencement of the storm, the first minimum value of N occurred at some time between 7h. and 7h. 30m., the trace being off the sheet in that interval. The first maximum value of W after the sudden commencement was at 7h. 10m., when it reached 188 γ above the undisturbed value. The declination at this time was 1° 18′ to westward of its amount before the storm began. The vertical force rose to a maximum at 7h. 13m., it being then 44 γ above its undisturbed value. Then followed a fall, on which were superposed numerous pulsations, to a minimum at 7h. 39m., and a recovery to a maximum 66 γ above the undisturbed value at 7h. 58m. Such changes in V during the early part of the storm are entirely unusual, both in character and amount.

During a magnetic storm the value of the vertical force usually rises to a maximum about 17h., the rise occupying about four hours, and being gradual though irregular. In the present instance, after the first few hours of the storm had passed, during which time the oscillations in V were unusually rapid, the value rose suddenly at 14h. 28m., the trace leaving the sheet at 14h. 55m., having risen 250 γ in this interval of twenty-seven minutes.

Other unusual features of the storm may be referred to, and one of these is the early hour at which the fall, after the maximum, in V took place. Usually this occurs about midnight, and includes two sudden drops in value. In the present case both occurred at unusually early hours, the first beginning at 19h. 22m., the second at 23h. 9m. The gradual recovery of the vertical force to its normal value is occasionally accompanied by pulsations. These were prominent on the morning of August 12. For example, during half an hour after 5h. thirteen oscillations were recorded with a mean amplitude of 4 γ. Another noteworthy feature of the storm was the intense agitation ("internal activity") in the horizontal components, especially after 2h. on August 12. As a rule, this is more prominent during the daylight hours of a storm; here it occurred during the night hours. Lastly, the disturbance was peculiar in the suddenness with which it ended about 19h. on August 12, and in the magnetically quiet conditions which succeeded it.

A. CRICHTON MITCHELL.

Eskdalemuir Observatory, August 14.

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